

CRUSADER



Army ACAT ID Program

Total Number of Systems:	1,138
Total Program Cost (TY\$):	\$21,573.5M
Average Unit Cost (TY\$):	\$18.96M
Full-rate production:	1QFY08

Prime Contractor

United Defense Limited Partnership

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2010

The Crusader system refers to a set consisting of the Army's next generation, 155mm, self-propelled howitzer (SPH) and its companion resupply vehicle (RSV). Crusader will be the indirect fire support system that provides direct support, reinforcing, general support reinforcing, and general support fires to armored and mechanized forces on the battlefield. The SPH is intended to provide significantly increased capabilities over the current M-109-series howitzer fleet. The M-109 was first fielded in 1963, and the latest model is the M-109A6, Paladin. The Crusader system is being developed to address present cannon systems' deficiencies in range, rate of fire, ammunition handling, mobility, survivability, and manpower requirements. The Crusader should provide more lethal firepower at longer ranges to support the *dominant maneuver* force.

The Crusader SPH will employ Advanced Solid Propellant Armament using a modular propellant charge system, auto-settable multi-option fuse, automated ammunition handling system, Global Positioning System (GPS)-based position location and azimuth reference system, and improved mobility and RAM. The SPH is required to deliver unassisted munitions at ranges to 30 kilometers and assisted

munitions to 40 kilometers. It will be designed to provide a maximum rate of fire of 10 to 12 rounds per minute for 3 to 5 minutes, and a sustained rate of 3 to 6 rounds per minute until on-board ammunition is exhausted. It is required to have the agility and mobility to keep up with the supported maneuver force of M1 tanks and Bradley fighting vehicles. Crusader is required to be able to complete a survivability move of 750 meters within 90 seconds of identifying a potential threat. The RSV sustains the SPH with ammunition and fuel. It will be a self-propelled armored vehicle with automated ammunition and fuel resupply functions, increased payload carrying capabilities (130 complete rounds), increased survivability, and GPS-based navigation system. The SPH and its RSV will each have a crew of three to replace the four and five crewmen, respectively, currently on the Paladin and the current M992A1 Field Artillery Ammunition Support Vehicle.

BACKGROUND INFORMATION

The Crusader SPH and RSV began as the Advanced Field Artillery System and Future Ammunition Resupply Vehicle. In 1992, the Deputy Under Secretary of Defense for Acquisition approved continuation of the Crusader programs to a Milestone I. Crusader Operational Requirements Documents were approved in June 1993. In November 1994, the program completed a successful Defense Acquisition Board Milestone I review and was authorized to enter the Program Definition and Risk Reduction Phase.

In March 1996, the Army decided to terminate liquid propellant development because of higher than expected technical development risks and the expectation that the solid propellant alternative could meet key performance parameter requirements at lower cost and less risk. In 1997, a decrement in program funding caused the Crusader program manager to revise the Acquisition Program Baseline, introduce a two-phase decision process for Milestone II, and slip the milestone review to 2001. IOT&E and the first unit equipped date remained in 2005.

In March 1998, the Program Executive Officer for Ground Combat and Support Systems and the Commandant of the Field Artillery School reviewed the system's maturity and approved entry into Phase II development.

On September 24, 1999, the Crusader Program Manager submitted a Program Deviation Report announcing that software development challenges would cause an additional Milestone II decision delay. Additionally, in October the Congressional Appropriations Conference reduced Crusader FY00 funding by \$75.8 million. The program is being restructured to accommodate the software development delays and reduced funding.

TEST & EVALUATION ACTIVITY

On February 5, 1999, DOT&E approved a Crusader TEMP that integrated the previous self-propelled howitzer and resupply vehicle TEMPs. The approval memorandum required a TEMP update for Milestone II to update the Live Fire Test and Evaluation strategy and develop additional Critical Operational Issues and Criteria, including platoon-, battery- and battalion-level mission accomplishment. DOT&E, as a member of the Crusader Test and Evaluation Working Integrated Product Team (IPT) and LFT&E Working Group, has assisted the Program Manager, Army Training and Doctrine Command and the U.S. Army Operational Test and Evaluation Command in developing Crusader test and evaluation strategy.

Developmental testing is being conducted in accordance with the TEMP. Modular Artillery Charge System XM231 module testing led to operational testing from September-November 1999. The Multiple Option Fuze Artillery Pre-production Qualification tests established firing tables for the new fuze. The Crusader XM297 cannon tube (with mid-wall cooling) and the laser ignition system underwent wear testing.

The contractor conducted component and subsystem testing in the System Integration Facility. Tests included gun and breech traverse and elevation, projectile ramming, and ammunition transfer and storage system performance testing. DOT&E visited the Crusader System Integration Facility in July.

During FY99, the Crusader program conducted an Engineering Development Test of Vulnerability Reduction Measures (EDT/VRM). Although the primary goal is to support the ongoing design process, the EDT/VRM program is identified in the TEMP as a key element of the LFT&E strategy and will serve as a significant data source for vulnerability evaluation. The FY99 EDT/VRM tests addressed the selection of fuel cell fire suppression methods, propellant compartment design, and ballistic performance of developmental armor designs including aluminum, composite, and top attack recipes. Propellant compartment and armor tests will continue through CY99.

The program received the first Crusader vehicle, the mobility platform RSV(-) in July and began automotive and reliability testing. The first howitzer (SPH1), with limited electronics and without its mobility subsystem, was expected to begin firing tests at Yuma Proving Ground in January; however, significant program restructure is ongoing.

The program office initiated semi-annual system-level reviews in the fall and spring to keep IPT members informed of program progress. Milestone II Analysis of Alternatives study guidance was issued and the study effort initiated.

As a result of the current Crusader restructuring, the Milestone II decision is likely to slip at least 18 months. DOT&E is working with the Crusader IPT's to help the Program Manager develop a new baseline schedule.

TEST & EVALUATION ASSESSMENT

Key areas of concern discussed at recent system-level reviews are software development, firing precision, tube wear life, transmission efficiency, howitzer vehicle weight, nuclear survivability, and reliability. Performance and reliability of the laser ignition and tube cooling systems are also major watch areas for DOT&E.

The re-supply vehicle will automatically transfer fuel and ammunition to the Crusader self-propelled howitzer. The automated ammunition handling system in the self-propelled howitzer will select and load the projectiles and charges for each fire mission. This is the first U.S. field artillery system to incorporate an automated ammunition and fuel loading and transfer system. Developing this computer-driven, mechanical system and the resupply vehicle-self propelled howitzer docking system (a fuel and ammunition transfer boom) will be a greater challenge than developing a traditional howitzer and re-supply ammunition handling system. The greater reliance on automated systems is also likely to have an impact on the Crusader's overall reliability.

Current LFT&E IPT efforts focus on developing a mature LFT&E strategy for incorporation into the Milestone II TEMP. Current schedules for supporting the Milestone are achievable.

LESSONS LEARNED

Crusader is a complicated system using an estimated 1.8 million lines of computer code. This software must accurately capture the mechanical tolerances—including changes due to wear and test—in many moving parts, and direct system actions and movements accordingly. As with all software-dominated systems, the ability of the software to model and accept both the intended performance of a complex system and its actual performance will be critical to overall success.